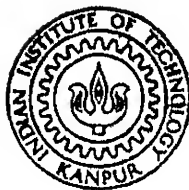


LOW CONFRONTATION BANKING SYSTEM

By

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DEPARTMENT OF COMPUTER SCIENCES AND ENGINEERING
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DECEMBER, 1984

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LOW CONFRONTATION BANKING SYSTEM

**A Thesis Submitted
In Partial Fulfilment of the Requirements
for the Degree of
MASTER OF TECHNOLOGY**

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**By
T. VENKATESWARA PRASAD**

**to the
DEPARTMENT OF COMPUTER SCIENCES AND ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY KANPUR
DECEMBER, 1984**

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~~CONFIDENTIAL~~

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ABSTRACT

A computerised banking system modelled after the existing banking system has been developed. The proposed system is designed such that it relieves the employee from the routine, mundane and error-prone work and leaves him free to do more productive work. The system proposes no reduction in the number of employees, but uses their energies in a more productive manner and hence increase the throughput rate in the bank (that is the banking hours are increased). The type of work, to which the employees are accustomed to, is not changed much in the proposed system so that the employee feels at home. This is done by combining the speed and accuracy of the machine with the intelligence of man for example by replacing all the books, Ledgers etc., by electronic files. The implementation is done on the Network Data Base System DBMS -10 on the DEC-1090 system at I.I.T. Kanpur.

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CHAPTER 1

INTRODUCTION

1.1 THE PROBLEM.

Let us define at the very outset what we mean by this term 'Low Confrontation'. We have, in this thesis, made an attempt to develop a computerised banking system modelled after the existing 'manually handled' system which can be accepted with little or almost no confrontation both by the employees as well as the management. This requires that there is no reduction in the number of employees and that there is minimal change in the type of operations they perform. At the same time, the proposed system tries to increase the efficiency both quantitatively and qualitatively.

In the proposed system the number of employees remain the same (and in fact more employment might be created in the long run because of increased business due to increased efficiency). At the same time, an increase in the business hours without additional workload on the employees is made possible by reducing the burden of manual paperwork and arithmetic work (of internal book-keeping) to a bare minimum which provides more time for

the staff to look after customers. Computational errors (previously due to the human factor) are also eliminated. In addition the system is so designed such that it is viewed by the bank employee as his assistant or friend and not as a competitor or rival.

1.2 MOTIVATION.

Given below are some of the facts which necessitate the search for new and better systems. (These facts pertain to those banks having a reasonably large business say for eg. 10,000 SB A/cs and 1000 Current A/cs)

(i) At present the time taken for withdrawing money in a bank (by a customer) is very large (taking any thing from half an hour to an hour).

(ii) Even in the Teller service the reliability lies on the Teller's knowledge and personal acquaintance of the customer and not on the balance in his account at that instant of time. Hence there is a chance of someone deceiving the bank. So a more secure and reliable system is to be devised.

(iii) The bank does not guarantee the stopping (payment) of the lost cheques since it is very difficult for the clerk to go through the ' lost cheques column ' in the Ledger for each and every cheque.

(iv) Even though the bank's business is closed at 2.30p.m. the task of internal book-keeping, most of the times is so large that those personnel connected with the book-keeping are not able to complete the work even by 7pm. (The no. of transactions to be entered in day-books are of the order of thousands).

(v) One of the many reasons for the present system being so slow is the fact that for every computation performed, a second person double checks it to avoid human errors.

Since these are some of the disadvantages in the present system, let us consider automated (almost unmanned) banking systems (which are becoming popular in the west). Even they are not suited for the Indian conditions since:

(i) They are very costly because they consist of cash counting machines, graphics systems to verify signatures, or Electromagnetic identification card readers and other expensive Hardware.

(ii) A large percentage of our population are illiterates or less educated. So they cannot operate directly the unmanned systems.

(iii) Since the employee-customer interaction does not exist, more business cannot be attracted.

(iv) And finally, due to the unemployment problem, we cannot and should not blindly follow the western example of unmanned systems.

1.3 THE PROPOSED SYSTEM.

All the physical ledgers and other books are replaced by electronic files. The entire data is stored in a database. A host of query programs operate on the database. Each Teller, Accountant and Counter Clerk has a Terminal (Video Display Unit) on his table into which he is prompted to type different queries regarding the accounts and the answers of those queries are displayed on the screen.

(i) Since the data is available almost instantaneously considerable speed can be achieved. (In the existing system the employee has to search for the required ledger, and turn over to the particular page etc.) This eliminates the physical movement of Books all around the place.

(ii) In this system the Teller can know what is the balance in the customers Account at that instant

by typing the A/c number. Hence there involves no risk in paying the customer by the Teller.

(iii) The business hours can be extended by atleast an hour because the entire work of internal Book keeping like updating Day books, Clean Cash Books, Transfer scroll etc. is done by the system.

(iv) The employees need not check the computation part of the transaction.

1.4 ADDITIONAL APPLICATIONS.

This package is meant not only for banks but also for those companies which accept Fixed Deposits and shares from public. For those companies only those query routines pertaining to Fixed Deposits are retained.

Since an employee Data Base is already existing in the proposed system, a pay-roll package can be added to it, and hence the employees salaries can be directly credited to their Accounts.

1.5 SUMMARY OF FOLLOWING CHAPTERS.

In the following chapters the implemented system is discussed in detail. Chapter Two is devoted to a description of the existing banking system. The various Record keeping Books, and the processing of different transactions are described. Those readers with a knowledge

of the internal procedures in a bank, can skip this chapter.

Chapter Three discusses the various design aspects of the implementation. It describes the data structures used, the various measures that have to be taken to ensure the smooth running of the system, like Concurrency, integrity, Crash Recovery etc.

Chapter Four describes the working of the implemented system and compares it with the existing system.

Chapter Five lists the Hardware required.

Chapter Six discusses further developments to the proposed system.

Chapter Seven concludes the Report.

CHAPTER 2

THE EXISTING BANKING SYSTEM

2.1 INTRODUCTION.

In this chapter the existing banking system is described. There is no single standard procedure for transacting business which is adopted in all the banks nor any literature is available on this topic. Different Banks adopt different procedures suited to their convenience. For the purposes of our implementation we chose the single entry book keeping system used by the STATE BANK OF INDIA. [1]

2.2 TRANSACTIONS.

Let us consider the most common transactions done in a bank. The most frequently performed transactions can be classified into three types.

(i) Depositing money (cash) into an account. (Be it Savings bank, Current Account, Fixed Deposit A/c etc.)

(ii) Withdrawing money (cash) from an A/c.

(iii) Transferring Money from one A/c to another, other less frequently performed transactions are:

(iv) Opening of an Account.

- (v) Closing of an Account.
 - (vi) Displaying the last n transactions of an A/c (ie; updating the passbook).
 - (vii) Accepting Fixed Deposits of Different types.
 - (viii) Crediting the customers SB/Cur A/c or Paying in Cash to the person for matured Fixed Deposits (of any type)on or after the Due Date.
 - (ix) To pay interest on Fixed Deposits.
 - (x) To cancel Fixed Deposits and pay the money before maturity.
 - (xi) To give loans to public accepting different items as security. (such as gold loans Deposit loans etc.)
- Now for every such customers-transaction, some internal book keeping has to be done. This requires the maintenance of
- (i) Day Books.
 - (ii) Clean Cash Books.
 - (iii) Transfer Scrolls.
 - (iv) Cash Scrolls .
 - (v) and to calculate interests of SB Accounts at regular intervals of 6 months.
 - (vi) To calculate the monthly/quarterly/ half-yearly /yearly interests of Fixed Deposits and to credit them to the Deposit holders A/c or pay it to him in cash etc.

2.3 RECORD KEEPING BOOKS.

Before trying to understand how the transactions are routed it is essential to know about the different books which are used and of the different entries which are made in them.

2.3.1 LEDGER.

The ledgers are those books in which the entire details of each account are maintained. These are those thick books with black (wooden) binding which we normally see at the counters. In these books two types of details are entered (a) The details of the Account and the Account Holder and (b) the details of the transactions done. The account and account holders details start on top of the first page and the transaction details follow (into other pages).

| | | | |
|----------------|------------|---------------|------------|
| Ledger Folio : | | Stopped Chq: | |
| A/c No: | | Standg. Inst. | |
| Name : | Occupation | Address | Issued Chq |
| | | | |
| | | | |

Fig 2.2.1(a) LEDGER.

(a) The details noted are:

- (i) the Name(s) of the customer(s).
- (ii) Occupation.
- (iii) Address (es).
- (iv) Account No. (and Ledger Folio)
- (v) whether the A/c has cheque Book Facility.
- (vi) If so, issued cheque books (Nos.),
- (vii) Lost Cheques (if any).
- (viii) Any special instructions given by the customer (known and Standing Instructions).

(b) The transaction details (fig 2.2.2) form a table containing:

- (i) Date of the transaction.
- (ii) Particulars of the Transaction.
- (iii) Amount debited (withdrawn from A/c)
- (iv) Amount credited (deposited in the A/c).
- (v) The Balance amount in the Account after that transaction.
- (vi) The initials of the staff making that entry.
- (vii) Products. The products entry is used for the purposes of calculating interests and is applicable only to SB A/cs. For further Description see section 2.4.12.

The pass book given to the customer is an exact copy of those pages, which correspond to his A/c.

| Date | Particulars | Debit | Credit | Balance | In tl | Pro- ducts |
|------|-------------|-------|--------|---------|----------|---------------|
|------|-------------|-------|--------|---------|----------|---------------|

Fig. 2.2.2 (b) LEDGER

2.3.2 FIXED DEPOSIT LEDGERS.

These books are similar to SB A/c and current A/c Ledgers. However a different set of details are noted. See fig. 2.2.3.

| | | |
|---------------|---------|---------------|
| Fixed Dep No: | | Int. A/c: |
| Folio No: | | Int Interval: |
| Int. Rate: | Amount: | Period: |
| Date Dep: | | Due on: |

| Names | Occupation | Address |
|-------|------------|---------|
|-------|------------|---------|

=====

Standing Inst:

=====

Fig 2.2.3 FIXED DEPOSIT LEDGER

- (a) The account details contain the following:
- (i) The Fixed Deposit No.
 - (ii) The Name(s) of the Deposit Holder(s).
 - (iii) Occupation.
 - (iv) Address(es).
 - (v) Amount of Deposit.
 - (vi) Interest Rate.

- (vii) Date on which the Deposit was made.
- (viii) Period for which the Deposit was made.
- (ix) The Due Date. (or the Maturity Date)
- (x) The time intervals at which interest is to be paid.
(whether at quarterly/ monthly/ half-yearly/ yearly rests)
- (xi) Whether the interest is to be credited to some account and if so the account's details.
- (xii) The date on which the interest should be paid.
- (xiii) Standing Instructions.

The only transactions that are done on fixed deposit A/c's are those when interest is paid at regular intervals.

- (b) The transaction (Interest Paid) entries contain (fig 2.2.4):

| Date Paid | Date till which Paid | Amount Rs. Ps | Date Paid | Date till which Paid | Amount Rs. Ps. |
|-----------|----------------------|---------------|-----------|----------------------|----------------|
|-----------|----------------------|---------------|-----------|----------------------|----------------|

Fig 2.2.4 INTEREST PAID ENTRY.

- (i) Date paid.
- (ii) The date till which interest was paid.
- (iii) Amount paid (Debit).

2.3.3 Cash Scroll.

The Cashiers are basically of two types. A payment cashier is one who pays cash to customers and a Receipts Cashier is one who receives cash from customers. A separate cash scroll register is maintained for recording payment and receipt transactions.

2.3.3.1 Cashier-Payment-Scroll.

It is maintained by payments cashiers. Whenever a payment is made to a customer an entry is made corresponding to it in the cash scroll. (fig 2.2.5) Each entry has a cash scroll No (a serial number given by the cashier), the Amount Paid, and the customers name and A/c No. Also noted are the starting cash (when the counter is opened) and the closing cash (when the counter is closed).

Cashier's Name :
Opening Cash Rs.

Payments/ Receipts
Date:

| Scroll No | Particulars | | | Amount |
|-----------|-------------|---------|------------|--------|
| | Ldg Fol, | A/c No. | Name | |
| xxxx | xx | xxxxxxx | xxxxxxxxxx | xxx.xx |
| xxxx | xx | xxxxxxx | xxxxxxxxxx | xxx.xx |

Fig 2.2.5 CASH SCROLL

2.3.3.2 Cashier-Receipts-Scroll.

This is similar to the above except for that this is maintained by a Receipts Cashier and that an entry is made whenever he receives some cash.

2.3.4 Transfer-Scroll.

This book keeps track of all transfers that have been made in/from/ to that branch office. (transfers are those transactions which do not involve money in the form of cash. for example Transferring money from one A/c to another by a cheque. etc. Each entry in the Transfer-Scroll consists of : the sending A/c's details (Debit A/c), Amount transferred, Receiving A/c's details (credit A/c), and Amount Received (equal to Amount transferred minus Exchange/ Commision) .

2.3.5 Day-Books.

All the transactions performed on a particular day for a particular A/c type are entered in this book. Separate Day Books are maintained for each A/c type. i.e; One day book for SB A/c's. One for Fixed Deposit A/c's etc. The

Date :

| Scroll No. | Credit A/c No. | Credit Amount | Particulars .. | Debit A/cNo | Debit Amount |
|---------------|-------------------|------------------|-------------------|----------------|-----------------|
| xxx | xxxx | xxxx.xx | xxxxxxxxx | xxxx | xxxx.xx |

Fig. 2.2.6 TRANSFER SCROLL

Day book entry is the final stage of a transaction indicating that the transaction is completed. (fig 2.2.7). The Day Book entry consists of :

(i) Serial No. (ii) The A/c No on which the transaction was done. (iii) Name of the customer. (iv) Debit Amount. (v) Credit Amount.

Date :

Account Type: (SB/ Current/ FDR etc.)

| Sl.No. | Folio and A/c No. | Name | Amount | |
|--------|----------------------|-----------|----------|---------|
| | | | Debit | Credit |
| xxx | x/xxxx | xxxxxxxxx | xxxxx.xx | xxxx.xx |
| xxx | TOTALS | | xxxxx.xx | xxxx.xx |

Fig 2.2.7 DAY BOOK.

2.3.6 Clean-Cash-Book.

The Day's transactions are summarised in this book. This contains (i) For each type of A/c's the no of Debit transactions. (ii) The total Debit Amount. (iii) The total no. of credit transactions. (iv) and the total credit amount.

Date:

| Credit Amount | No of Vouchers | Type of Account | No of Vouchers | Debit Amount |
|---------------|----------------|-----------------|----------------|--------------|
| xxxx.xx | xxx | S B | xxx | xxxx.xx |
| xxxx.xx | xxx | Current | xxx | xxxx.xx |
| xxxx.xx | xxx | T D R | xxx | xxx.xx |
| xxxx.xx | xxx | Tfr. Scrl | xxx | xxxx.xx |
| T O T A L S | | | | |

Fig 2.2.8 CLEAN CASH BOOK.

2.3.7 Transit (Voucher) Register.

This book (see fig 2.2.9) acts as a sort of ' loss free channel' through which different papers (cheques etc.) are passed on from one hand to another in the bank. Its purpose is to mainly impose a security check so that no important paper is lost while in transit. For example when a Passing Official (the Accountant; after

passing a cheque) wants to send it to the cashier (thru a messenger) , he puts his initials and a serial No. and the physical Cheque in this Register and sends it to the cashier. The cashier then takes the cheque after acknowledging for it (By putting his initials across the entry made by the passing official).

| Serial No | Scroll Sl.No. with Prefix | Sender (Passing Official) | Receiver (Paying Cashier) | Passing Official (Acknldg) | Cln.Cash Book Writers Intls |
|-----------|---------------------------|---------------------------|---------------------------|----------------------------|-----------------------------|
|-----------|---------------------------|---------------------------|---------------------------|----------------------------|-----------------------------|

Fig 2.2.9 TRANSIT VOUCHER REGISTER.

2.4 PROCESSING OF TRANSACTIONS.

Now let us examine how each of the transactions are processed. For each of the below cases see the respective Figures (2.3.*) for the line of flow of transactions.

2.4.1 WITHDRAWAL.

(By a Chq. or Withdrawl Form (WF) in the 'TOKEN' method),

Ledger keeper receives the Choque/WF from the customer and gives the customer a token (with a unique Number on it) after noting the token number on the cheque. Then after verifying the balance he makes the entry for that

withdrawal in the ledger and gives the ledger together with the cheque for passing (validation) by the Accountant. The passing official then verifies the signature on the cheque by comparing it with the specimen signature (given by the customer at the time of opening the A/c), satisfy himself that the entry made in the ledger and the computation is correct, the cheque was not a lost or stopped cheque and finally will have a look at the Standing Instructions before Passing the Cheque. The cheque is then validated by stamping the cheque ' P A Y C A S H ' and by putting the Accountants initials against that entry in the ledger and Passbook and on the cheque. This process of validation is called passing. After that the cheque is sent to the payments Cashier thru the Transit Voucher Register. The cashier then calls out the Token Number, pays cash to the customer and enters into his cash scroll. The cheque is then sent to the pigeon hole racks where papers are sorted according to the day-books into which they are to be entered. At the end of the day all such transactions collected in the pigeon holes are entered into their respective Day-Books. Then the summary of the Day-Books is entered into the Clean Cash Book.

WITHDRAWAL.

CUSTOMER---> (SUBMIT THE CHQ/WF) ---> LEDGER KEEPER

(MAKES THE ENTRY) --->* TRANSIT VOUCHER REGISTER* --->
 ACCOUNTANT (SIGN VERIFICATION AND PASSING) ---> CASHIER
 (CASH-SCROLL ENTRY AND PAYING CASH) --->* TRANSIT VOUCHER
 REGISTER* ---> (DAY BOOK ENTRY) ---> (CLN.CASH BOOK).

Fig 2.3.1

2.4.2 WITHDRAWAL. (AT TELLER).

To provide a faster service to those customers who want to withdraw small amounts personally, the TELLER service is provided. Here amounts less than Rs. Two Thousand are paid instantaneously against Cheques/(WF). The TELLER only checks the signature of the customer and if he is confident of the customer, pays him the amount. Otherwise the customer is advised to follow the conventional 'Token' method. After paying cash to the customer the TELLER makes an entry in his cash Scroll and sends the cheque to the Ledger Keeper who then makes an entry and the Accountant validates it. The cheque is finally sent for the Day-Book entry.

WITHDRAWAL (TELLER)

CUSTOMER ---> TELLER (CASH-SCROLL, SIGN VERIFICATION AND PAY CASH)---* TRANSIT VOUCHER REGISTER* ---> LEDGER KEEPER (MAKE THE ENTRY)---> ACCOUNTANT (PASS)---> (DAY BOOK ENTRY) ---> (CLEAN CASH BOOK).

Fig 2.3.2.

2.4.3 DEPOSIT.

Deposits of cash are made by a form called the Pay-in-slip. This slip and the cash are received by the Receipts Cashier who gives his scroll No. to it, makes an entry in his cash scroll and sends it to the Head Cashier for verification. The Head Cashier will verify that the amount in words and figures are tallying, and whether the cashier has entered into the cash scroll correctly or not. In fact the Head cashier just does a double check. He then signs the counterfoil of the pay-in-slip and gives it to the customer and sends the slip to the Ledger keeper through the Transit Voucher register. The Ledger Keeper then makes an entry in the ledger and passes it on to the Accountant to validate it. At the end of the day's work all the pay-in slips so collected at the Accountant are entered into their respective Day Books. (Though the process of entering in the day book should be done immediately after a transaction, normally it is done once, for all the transactions, after the days business is over. This is purely due to practical convenience).

DEPOSIT,

COUSTOMER (DEP.CASH) ---> RECEIPTS CASHIER (CASH SCROLL)
 ---> HEAD CASHIER (DOUBLE CHECK AND ISSUE RECEIPT)
 --->LEDGER KEEPER (MAKE ENTRY)---> ACCOUNTANT (PASS IT)
 --->(DAY BOOK) ---> (CLEAN CASH BOOK).

Fig. 2,3.3

2.4.4 TRANSFERS.

(or depositing of money by a cheque).

The cheque with the filled in transfer-slip is received by the counter clerk and sent for clearing if it is an outstation cheque. Otherwise it is sent to the ledger keeper who makes the debit entry and passes it on to the Accountant. The Accountant will pass the cheque which, will then be entered in the transfer scroll. At this point the cheque and the transfer slip are separated. The cheque is sent for entering into the day book (Debit entry) and the transfer slip is sent to the Ledger keeper who makes the credit entry and gets it validated by the Accountant. Finally it is sent for the Day Book entry (Credit).

```

CUSTOMER ( SUBMIT CHEQUE AND TRANSFER SLIP)----> LEDGER KEEPER
( MAKE THE DEBIT ENTRY ) --> ACCOUNTANT ( PASS THE DEBIT
ENTRY) ----> (TRANSFER SCROLL ENTRY) ----> (SEPARATE CHEQUE )---->
( DAY BOOK ) --> ( CLN CASH BOOK).          L--> TFR SLIP)
----> LEDGER KEEPER (MAKE CREDIT ENTRY )----> ACCOUNTANT (PASS IT)
----> ( DAY BOOK ) ----> ( CLEAN CASH BOOK).

```

2.4.5 Opening A New A/c.

A duly filled in application form is given to the Accountant by the customer who wants to open an account.

He also makes a Deposit (in Cash and not less than Rupees One Hundred for Accounts with Cheque Book facility/ Rs. Ten for ordinary A/c's) with the Receipts cashier (the pay-in-slip being marked ' New A/c'). This deposit is processed as any ordinary deposit and when the pay-in-slip reaches the Accountant, he gives a new A/c number, opens a new page in the ledger for that A/c, enters all the details together with that of the deposit made, and then sends the pay-in-slip for the day-book entry. The Accountant also takes three specimen signatures of the customer on a special form which is placed in a signature ledger. (It is a ledger which is referenced by the Accountant at the time of verifying signatures on cheques etc.)

2.4.6 Closing an Account.

When the customer expresses his wish to close his A/c, the interest is calculated up to that date (if it is an SB A/c) and added to the balance. The balance is then told to the customer who prepares a cheque for that amount. The cheque is processed as any other cheque and hence the balance becomes zero. The Accountant then closes the A/c by mentioning the same on the Ledger and in the passbook. He then cancels the pass book and returns it to the customer.

2.4.7 Updating The Pass book.

Though the pass book is expected to be submitted with every transaction, it is seldom done so. Hence to make the Ledger and the Pass Book agree, some entries might have to be made in the pass book to keep it up to date, or to know the current balance. This process is called the Updating of the pass book. The Ledger keeper makes all the unentered (into the Passbook) entries and the Accountant puts his initials after verifying them.

2.4.8 Accepting Fixed Deposits.

Fixed Deposits are mainly of two types, (i) Those for which interest is given at regular intervals (called Term Deposits) and (ii) Those for which no interest is paid during the period of deposit, but instead a lumpsum is paid at the end of the period for which it is deposited. The Deposit can be made in Cash with pay-in slip at the receipts Cashier. The pay-in slip is sent to the Fixed Deposit Clerk after the Head Cashier verification. The FD Clerk then opens a new page in the FD Ledger and enters the details of the Deposit as given in the Fixed Deposit Application Form. He then issues a FD Receipt to the customer after getting it signed by the Br. Manager. The pay-in slip is then sent for the Day Book entry.

2.4.9 Repaying Matured Deposits.

All types of FD's cease to accrue interest from the date of maturity unless they are renewed, (even if the amount is lying with the Bank). The customer claims the amount (after the Due Date or by a requisition to cancell the deposit if it is before the Due Date) by surrendering the FD Receipt duly stamped and signed, to the Bank. After the FD Clerk satisfies himself that the FDR is complete in all respects, he first finds out whether there is any interest due and prepares a Debit Voucher for the interest (which is calculated upto the Due Date), (also see Sec 2.4.10). Then another Debit Voucher is prepared for the principal amount. These vouchers are verified and signed by the Br. Manager/ Accountant. Then one of the following procedures are adopted depending on whether the customer wants the payment to be done in cash or credited to his A/c.

2.4.9.1 Payment In Cash.

A token is issued to the customer and the Debit Voucher(s) are sent to the paying cashier thru the Transit Voucher Register. After the cashier pays and enters into his scroll, the voucher is sent for Day Book entry.

2.4.9.2 Payment By Crediting To A/c.

With the above prepared Debit Voucher(s), Transfer Slips are also prepared and a scroll No is given to the transaction. They are then entered into the transfer Scroll and are separated. While the Debit Voucher is sent for the Day Book entry, the transfer slips are sent to the Ledger Keeper for making the Credit entry. After the credit entry is passed the Tfr. slip is sent for the Day Book Entry.

2.4.10 Cancellation of FD's.

Cancellation is the premature repayment of the Deposit. It is granted as a special case and in such cases the amount due to the Depositor is calculated as follows. The total amount of interest given to the customer till the date is calculated. Had the amount been deposited only for this (reduced) time period, the amount that will be due to the customer as interest (this will be at a lesser int. rate) will be calculated. Hence the amount due will be the Amount of Deposit plus the interest due minus the interest already given, and it is paid to the customer as described in 2.4.9.

2.4.11 Payment Of Interest Of FD's At Regular Intervals.

The last interest-paid entry in the Ledger contains the date till which the interest has been paid. The interest for the next interval is calculated and a Debit Voucher is prepared. If the customer wishes for a payment in cash then it is done as in 2.4.9.1. But if the customer wishes that the interest be credited to his A/c, the procedure is slightly different. Every day in the morning the FD Clerk prepares Debit Vouchers and Transfer slips for all those Deposits for which an instalment of interest is due on that day. They are then entered in the Transfer Scroll and then the procedure is the same as in 2.4.9.2.

2.4.12. Calculation of SB Interests.

On the first day of every April and October, interests for SB A/c's for that half year are calculated. For the purposes of calculating interests the minimum balance during the 10th and the month ending of any month is taken as the average balance for that month and hence the interest is calculated for that amount. The PRODUCTS field in the Ledger contains (the sum of (the products of- the average balance-with-the time of that balance.)) Hence the products multiplied by the Interest Rate (as a %) gives the interest.

CHAPTER 3

DESIGN OF A COMPUTERISED SYSTEM

3.1 INTRODUCTION.

In the previous chapter we have seen what are the different Books and entries and how different transactions are performed. Now in this chapter we will try to implement each of these Books/entries as records in the Network Data Base, and to implement these transactions in such a way that there is communication between the concerned employees (via the system) in the form of transactions. In this chapter the term transaction may cause some confusion, so let us first clarify what we mean by transactions. We use the term transaction in this chapter (only) with the meaning of the CODASYL terminology which defines a transaction as a sequence of DML commands [3] which are executed one by one as a single entity. Outside this chapter we mean transactions to be the customers transactions like withdrawing money from an A/c etc...

3.2 ARCHITECTURE .

The underlying architecture of the system is shown in fig 3.1. It consists of three areas, (i) a LEDGER-AREA, (ii) an internal area (EMP-TRAN-AREA), and (iii) a

daily internal area (INTRNL-ACC-AREA). While almost all the employees have read access to the LEDGER-AREA, only some employees (i.e; Accountants and Authorising Officers) can update it. The second area (EMP-TRAN-AREA) is available to all with update access. The third area (INTRNL-ACC-AREA), is different for every working day, and is changed every morning. All the day's books, cash scrolls etc. are stored in this area and it is available with update access to all those types of employees who require it.

The communication between the different employees is by means of the EMP-TRAN-AREA. For any transaction first a Transaction frame is prepared and put into the EMP-TRAN-AREA. The employees who come next in the transaction flow diagram takes this frame out from EMP-TRAN-AREA, modify the required data in different areas and puts the transaction frame back into the EMP-TRAN-AREA. Finally when the transaction is complete the Transaction frame is deleted from EMP-TRAN-AREA. All activities in the system are user triggered.

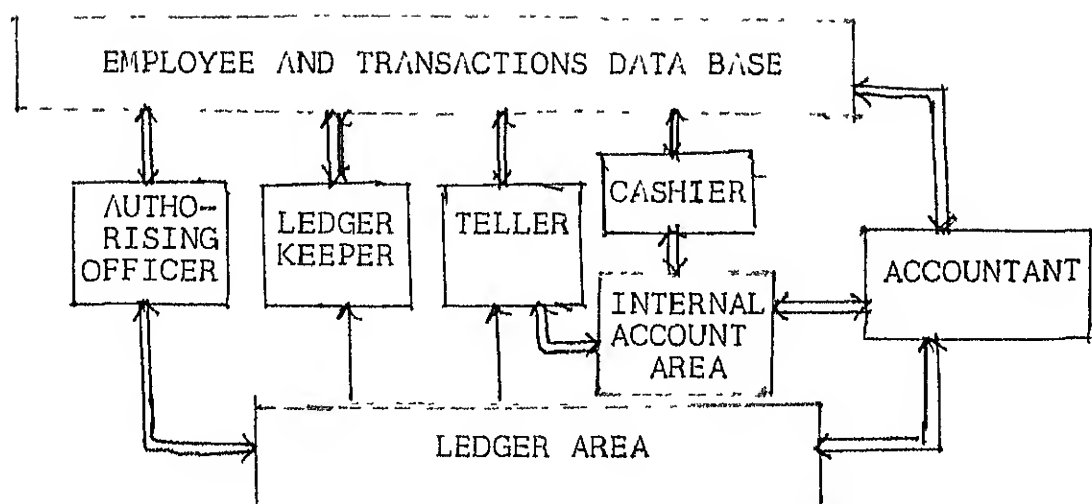


Fig 3.1 Architecture

----> Unidirectional Data flow

==== Bidirectional Data Flow

3.3 THE DATA MODEL.

3.3.1 LEDGER AREA.

In this area all the accounts are classified into two different types. (a) Accounts for which there is no time limit; eg. SB A/c's Current A/c's and Loan A/c's. (b) and Fixed time A/cs. All the Fixed Deposits, Cumulative Deposits etc come under this category.

Each of these two types are represented in the Data Base by the respective type of records, 'ACC-REC' and 'FIXED-DEP-REC'. (a) ACC-REC contains all the details shown in fig 2.2.1 and all such ACC-REC's can be randomly accessed

using the account number as the key (CALC mode). The entries (or customer transactions on those A/c's) are represented by ' ENTRIES-REC' Records and they contain all the details shown in fig 2.2.2 (one entry corresponds to one customer transaction or one line in the Ledger Book / Pass book). All such ENTRIES-REC's are linked as a chain and attached to their ACC-REC's with sequential access to the ENTRIES-REC's through their ACC-REC's (VIA mode).

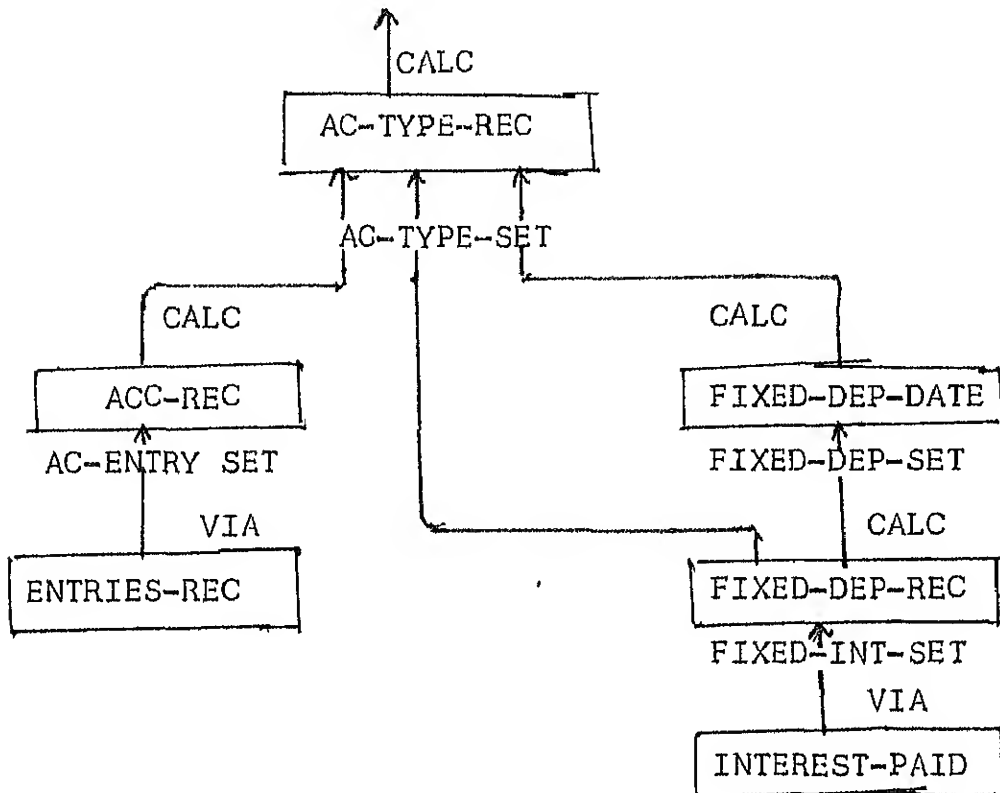
(b) FIXED-DEP-REC contains all those details shown in fig 2.2.3, the access being random (the key is the customer's name). The only entries such A/c's have are 'INTEREST-PAID' entries and they are represented by 'INTEREST-PAID' records and correspond to fig 2.2.4. These INTEREST PAID records are linked as a chain to their FIXED-DEP-REC's (access is sequential VIA).

For each type of A/c's (SB, Cur, Fixed, Cumulative, Loans etc.), an ' AC-TYPE-REC' is maintained which contains the total number of A/c's of that type and Interest Rate fields. This is to facilitate grouping of ACC-REC's / FIXED-DEP-REC's of one type together and for easier accessing. So all those ACC-REC's of SB A/c type are headed by one AC-TYPE-REC, and so on.

3.3.2 EMP-TRAN-AREA .

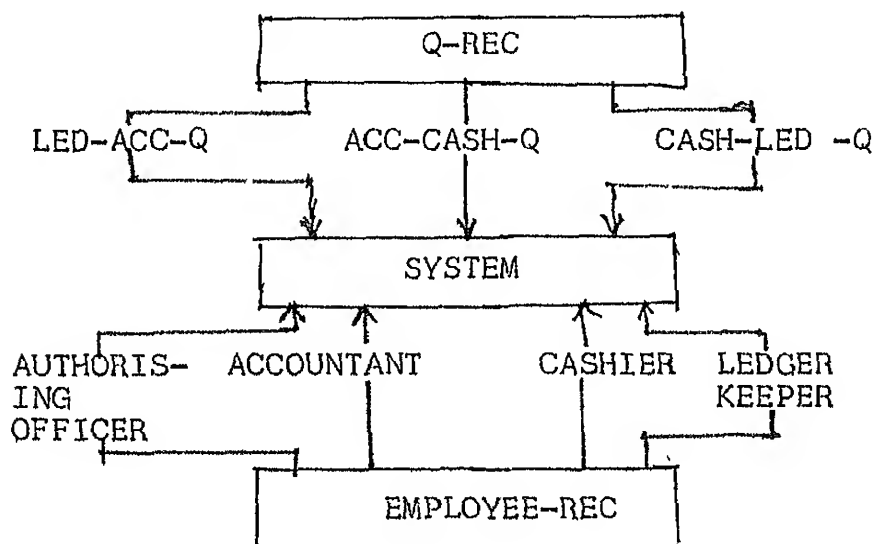
3.3.2.1 Employee Data Base.

The EMP-TRAN -AREA contains records of two types . One is the EMPLOYEE-REC's which constitutes the employee Data Base. The employees are classified into four categories. (i) AUTHORISING OFFICERS, (ii) ACCOUNTANTS, (iii) CASHIERS, and (iv) LEDGER-KEEPERS. All the employees of one category enjoy identical privileges and hence are grouped together to form a chain with the ' System' record as the owner. The EMPLOYEE-REC has fields Name, Designation, Employee's Initials (which are used in all entries made by the employee and are identified with him), a secret password and his present status (whether he is free or working in some Application Program at that moment of time). This Employee Data Base is required for the purposes of security.



3.3.2.2. Transaction Area.

Every active transaction is represented by a frame 'Q-REC' containing the details of the Transaction. It contains the transaction Number, 'TOKEN-NO', the A/c No, Name, Particulars, Credit, and Debit. These 'Q-REC's are Classified into three groups. (i) the LED-ACC-Q. Those transactions that have been processed by the Ledger Keeper and are waiting to be passed by the Accountant are in this group. (ii) the ACC-CASH -Q. Those transactions that have been Passed and are awaiting payment (by the cashier). (iii) the CASH-LED-Q. Those transactions that have been processed by the cashier and Head-Cashier, are awaiting further processing. For all these three groups the access to 'Q-REC' is random (the CALC key is ' TOKEN-NO'). Also sequential access is provided VIA each of the above three groups (chains).



(11) EMP-TRAN-AREA

3.3.3 INTRNL-ACC-AREA.

In the INTRNL-ACC-AREA all the days books like Cash-Scrolls, Transfer-Scroll, and Daybooks are stored. A 'TO-DAY-REC' record is maintained which contains the date, on which the area has been used, the transfer Scroll totals (Debit and Credit), the Clean Cash totals (Debit and Credit). The access to it is random, key being TO-DAY (the date). The day books are represented by ' DAY-BOOK-REC's one each for every different type of A/c. The access is random (CALC key being Day Book Type). Each entry in the day book is represented by ' DAY BOOK ENTRY ', and all such entries are linked to form a chain with the Day-Book-Rec (as the owner). The access is sequential (VIA the Day-Book-Rec). Similarly for every cashier there is a Cashier's Scroll Record stored with the cashiers's initials and the mode in which he is working. (random access, and CALC keys are Cashiers-Initials, and the mode). Each Cash Scroll entry is represented by a 'CASH-SCROLL-ENTRY' and all such entries are linked to form a chain with the cashier's Scroll (the owner). The access is sequential (VIA the CASH-SCROLL -SET).

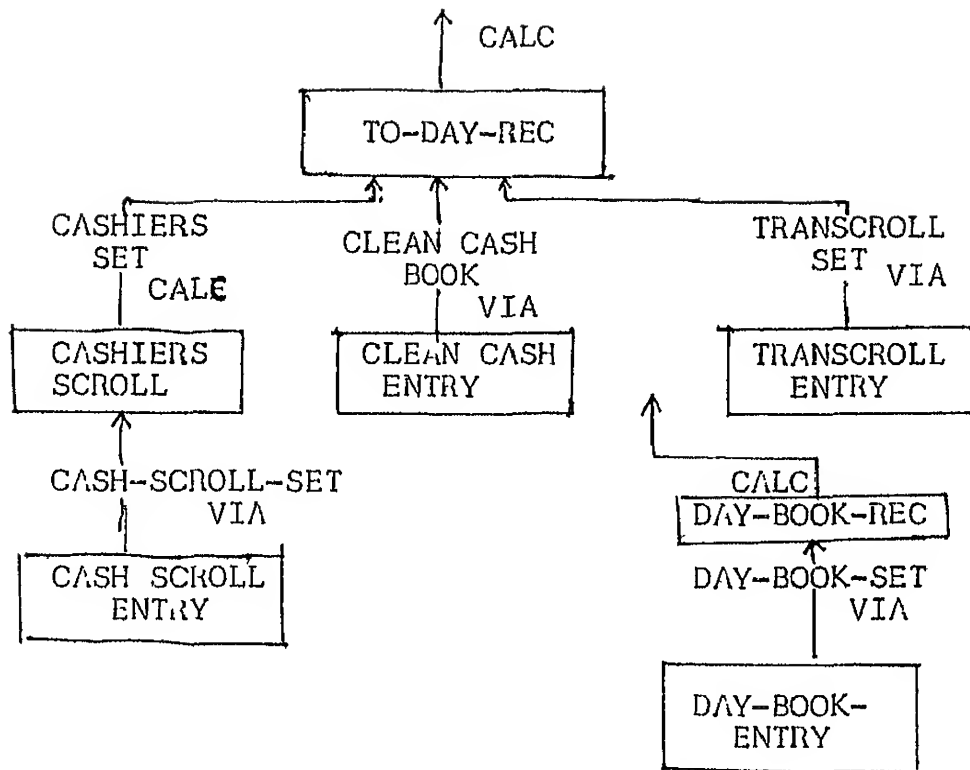


Fig 3.2 (iii) INTRNL-ACC-AREA

3.4 CONCURRENCY.

The different employees like cashiers, Accountants, Fixed Deposit Clerks work concurrently, the interleaving unit [4] being both transactions and commands. Because some of the customers transactions are interactive, retaining the Data Base exclusively for that employee (run unit) for the entire duration of the customers transaction, results in very poor concurrency or almost no concurrency (and at times the entire bank can come to a standstill if a clerk starts

chatting to someone without finishing the interactive part of the customer transaction). Hence the customers transactions are divided into phases such that the interleaving unit will be one phase and all the user interaction will be done only between two phases and not in the middle of a phase. So the concurrency problem is solved.

3.5 INTEGRITY.[4]

The method mentioned above while solving the concurrency problem poses a new problem. Integrity constraints require that a particular data be exclusively retained by a run unit till the customers transaction is completed. To simplify the matters consider the following example. For withdrawing money, the balance is displayed to the Accountant and after his consent is obtained, the amount withdrawn is subtracted from the balance. This requires that the balance is not changed while the Accountants reply is awaited. But in the method suggested above this is not possible because the balance can be changed by another run unit while the transaction is between phases. So to avoid this (This problem arises only with SB A/c's and Cur A/c's), a lock has been designed at the account level. So at the beginning of the customers transaction (in the first phase) the Account is locked, and the balance displayed. After the user interaction is over, in the second phase the changes

are made and the account is unlocked. And while the Account is locked nobody can change the details in the A/c and hence the A/c is exclusively retained by the user.

3.6 SECURITY.

The access to the Data Base is provided by means of privacy keys. Privacy keys are those character strings without whose knowledge the Data Base is not accessible even through the system utilities. (privacy keys are those which are given and maintained by the system designer.) Even the access to the Data Base, thru the Application programs is controlled by a password. A password is a user (employee) defined string which allows the user to use the particular Application program. So with both the above mentioned scrutinies it is ensured that only those employees who are authorised to access the Data Base, are let through. This necessitates the maintaining of an employee Data Base. Since there are four categories of employees, an employee can not access all the Application Programs except those which are allowed to be accessed by his category. For example an employee of the clerk category cannot access the Application Program meant for the Accountant etc. All the modifications done to the Data Base have the modifiers initials entered with the modification so that for every

modification, the person who has modified it can be identified. It is advised that whenever the employee leaves his seat (even for a short while) he should come out of the loop (sec 4.2.4)(by selecting the function OVER) so that in his absence nobody can do modifications (because those modifications will bear his initials).

3.7 CONSISTENCY.

Some consistency measures taken are :

(i) no two application Programs (especially in cashier modes) can be run by an employee at any given instant of time. That is an employee can run only one Application Program at a time.

(ii) no two cashiers can operate from the same cash counter.

(iii) the total transactions done in cash or the final difference in the debit and credit totals of all the cashiers should be equal to the corresponding clean cash book figures.

(iv) even if a crash occurs, (possibly in the middle of a transaction) the Data Base should be consistent. To make this point clear consider the following situation: In a withdraw transaction after the Ledgers have been updated, while the Day Books are yet to be updated, a crash occurs.

After the system comes up again, the system will be in an inconsistent state since there is an entry in the ledger without a corresponding entry in the Day Book. So after the crash, the system is to be brought to a consistent state, either by making the corresponding entry in the Day Book and completing the incomplete transaction, or by erasing the update done to the Ledger and thereby undoing the incomplete transaction (and informing the user to enter the details once again and start the transaction from the beginning).

3.8 CRASH RECOVERY.

The crash recovery is done by first undoing all the incomplete transactions and bringing back the Data Base to a consistent and valid state. Then an Application Program is run which does the following.

(1) Find all those customer transactions which were stopped in the middle. This task is relatively simple since for every active customer transaction there is a frame containing the details of the customer transaction which is of course moving, floating around as the customer transaction progresses. So by scanning all the frames (Q-REC's) one can know all the incomplete transactions, along with the extent to which they have progressed.

(ii) Try to complete them as far as possible. Those transactions that can be completed are completed and a

message is displayed saying that the particular transaction has been completed. Consider a situation in which, in a transfers transaction, after the Accountant has passed the transaction, the Debit phase has been completed and then, before the credit phase could be completed, a crash occurs. Since this transaction no more involves the user, it can be completed.

(iii) Release all the Locks. If a crash has occurred after the first phase of a customer transaction, (after locking the A/c) the Data Base will be restored to the beginning of the second phase. (to the point where the user interaction ends). Since the accounts referenced in the transaction will remain to be locked, they are to be released to enable further transactions to be done on those A/c's. Hence all those A/c's referenced in the Q-REC's (incomplete transactions) are unlocked. This enables the Accountant to select the appropriate function and start that part of the transaction all over again. As an example, if the withdraw transaction was in progress, in the Accountants hands, the the first phase of the transaction (locking the A/c) has been completed, and while or after the Accountant was giving his consent to pass the transaction, but before the second phase has been completed, a crash occurs. After the Data Base is restored, the A/c still remains to be locked. Hence

after unlocking, the Accountant can start it again by selecting the withdraw function.

(iv) Mark the status of all the employees ' free' . Since at the time of crash, the Application Program in which an employee was working, is marked as his status (in the Employee Data Base), (this is to avoid one employee working in two Application Programs at the same time), all the employees status is marked ' free' so that they can start with their Application Programs (from the beginning).

(v) And finally, to produce a list of all those incomplete transactions mentioning the extent to which each of them has progressed and Indicating the point from which they have to be resumed. Also the last entry of each of the Day Books, Cash Scrolls and Transfer Scroll are displayed/ printed*.

* The printing routine is available as an option.

CHAPTER 4

THE IMPLEMENTED SYSTEM

4.1 INTRODUCTION

In this chapter the working of the implemented system is described. The implemented system is compared with the existing system and the contrast is highlighted. All the books mentioned in sec. 2.2 (except TRANSIT VOUCHER REGISTER) are maintained as disk files.

4.2 THE ROUTINES.

The developed package consists of the following routines. SYSTUP, OPNDAY, APPOIN, ACC, LOG, CASH, FIXED, CLS (close day), CRSHRC, ACCLST. All these routines are in COBOL, interleaved with DML commands of DBMS-10 [2],[3]. The functions they perform are described below.

4.2.1 SYSTUP.

Initially when the system is commissioned (a new bank/ branch is started) the necessary infrastructure in the Date Base must be built up and some initialisations are to be done . These involve the setting up of header records for account-records as well as employee-records, setting up the internal (current) accounts like ' fixed deposit interest A/C' and also to initialise the employee database with some employees who can authorise the appointment

of other employees. Transactions are performed by the routine SYSTUP. (This routine is executed only once in the entire history of the bank).

4.2.2 OPNDAY.

Every day in the morning when the bank starts its business there are some initialisations to be done ie. setting up of new day books, cash scrolls, transfer scroll and calculating the fixed deposit /SB Ac interests due to the customers upto that day. (That day and the immediately preceding holidays) These are the functions of the routine OPNDAY. For the purpose of interest calculation the date (TO-DAY) is stored in the database every time OPNDAY is executed thereby making the immediately previous working day (the date till which interests have been calculated) available next time we execute OPNDAY. So calculations are done for all deposits for which interests are due on the days between the last working day and today (inclusive of today). OPNDAY is executed once in the morning of every working day.

4.2.3 APPOIN

As mentioned in chapter Three there are four types of employees.

(i) Those who can authorise the employment of other employees, open and close the day's transactions, (branch manager etc.)

(ii) Those who can authorise the entries (do modifications) to the Data Base (accountants, head cashiers etc).

(iii) Those who deal with hard cash (cashiers) and

(iv) Those who only have read access to the Data Base (clerks etc.).

This routine APPOIN deals with the appointment (authorisation) and termination (SUSPENDING of authorisation) of employees. However to have access to this routine N (3 in our implementation; N is declared in SYSTUP) authorising officers have to authorise. i.e., for authorising, suspending an employee, 3 different authorising officers have to key in their passwords one after other. (This routine can be executed at any time to authorise / suspend an employee). This routine also lists all the employees in the bank (except their passwords).

4.2.4 ACC.

All the accounta^{nts} duties are incorporated into this routine. To gain access to this routine, first the date of that day is to be given, and only after ensuring that the

day's books are open, the system asks the accountant to give his code and password. Upon checking the authority of the accountant, he is made to enter a loop in which he selects different functions, performs them and returns to the beginning of the loop. The different functions which he can perform are

(i) Withdrawal : He can-pass a cheque (or WF*)/ invalidate it, the entry of which was made by the ledger keeper (who has also sent the cheque/WF to him.)

(ii) Deposit: He can-validate/ invalidate-a deposit entry which was made by the ledger keeper/cashier.

(iii) Transfer: He can-pass the transfer/ invalidate it-the entry of which is made by the ledger keeper.

(iv) TELLER WITHDRAW : To receive the cheque from the ledger keeper which has already been paid and-validate/ invalidate-the entry.

(v) Open A/C: Open an a/c by receiving the pay-in-slip from the cashier and the application from the customer.

(vi) Close A/C: Receiving an application from the customer, tell him the balance and receive a cheque/WF for the balance amount and close the A/c.

(vii) Change address: Change the address noted in the customers A/c.

(viii) Cheque lost: If a cheque is lost/ found modify the cheque lost information of that account.

(ix) Standing instructions: Change the standing instructions of an a/c.

(x) Come out of the loop and stop doing transactions: When the accountant is leaving his seat for a while he is advised to come out of the loop so that nobody can use his authorisation and do some transactions (when he returns he can again enter into the loop by starting from the beginning i.e. by running ACC).

4.2.5 LDG

All the duties of the counter clerks (ledger keepers) are incorporated in this routine. Access to it is controlled in a manner similar to that of accountants routine (as above). After the authenticity of the clerk is established, the routine enters a loop in which he can select and perform the following functions.

(i) Balance : To display all the entries from a given date till today for a particular account and update the passbook of the customer.

(ii) Withdraw: To accept a cheque/WF from customers, check the balance in their a/c and then enter the details of that cheque/WF, issue a token to the customer and forward the cheque/WF to the accountant.

(iii) Teller withdraw: To receive a cheque which has been paid by the teller, make the entry and forward it to the accountant.

(iv) Deposit : To receive a cleared out station (branch) cheque's/ draft's transfer slip (from the clearing dept.) or any sort of Credit voucher, enter the details of that and forward it to the accountant.

(v) Transfer: To accept a cheque (belonging to the same branch along with a transfer slip from the customer, enter the details and forward it to the accountant.

(vi) Over:Come out the loop and finish.

4.2.6 CASH.

This routine serves for all the four types of cashiers i.e; Payment Cashiers, Receipts Cashiers, (Payment) Tellers, and Head Cashiers. An authorisation check is performed in the beginning which asks for the cashiers initials and password. Upon the successful completion of this check, the user can choose one of the four types.

4.2.6.1 Head Cashier:

The control then enters a loop, and in every iteration, a scroll number is asked for. When a no is keyed in, the cash scroll entry corresponding to that number is displayed. After the head cashier checks the entry, he validates/ invalidates it. After every such iteration he has the option to come out of the loop.

For all the next three types, the opening cash is to be entered in the beginning and the control enters a loop. After every iteration the cashier has the option of coming out of the loop by typing 'N' to the query ' Continue?>>'. After he comes out of the loop the closing cash is displayed. Also whenever the cash in the box falls below a certain minimum, a message is displayed to that effect.

4.2.6.2 Payments Cashier :-

In every iteration, first all the token Nos awaiting to be cashed are displayed. When the cashier receives one of those tokens from a customer, he types in the token No and the details are displayed. Then he types in 'Y' if he decides to pay cash, (thereby the system makes the cash scroll entry and the Day Book entry).

4.2.6.3. Receipts Cashier :-

Whenever he receives some money, he enters the particulars , the system makes an entry in the cash scroll and displays a scroll number which is the no of that transaction. The cashier then enters that number on the pay-in-slip and sends it to the Head Cashier for validation.

4.2.6.4 Teller:-

Upon receiving a cheque from a customer, he enters the account number and the system displays the balance and other details of that account. The teller then, after deciding whether to pay the cash, pays the cash and enters the details of the cheque. The cash scroll entry is done by the system. The cheque/ WF is then sent to the Ledger Keeper.

4.2.7 FIXED.

This routine is meant to be used by the Fixed Deposit Clerk. An authorisation check is performed first and the control enters a loop. In the loop he selects different functions, performs them and returns to the beginning of the loop.

(i) PAYINT : The interests of a particular deposit are calculated and paid to the customer (either by Cash or by Crediting to his account).

(ii) ACCEPT: To accept a fixed deposit by receiving the pay-in-slip from the cashier or a cheque from the customer and the application form.

(iii) LIST: It asks for a name and then lists all the deposits made on that name.

(iv) REPAY: It asks for a name and displays all the deposits on that name, and when the system displays the required Deposit, the user types in 'Y'(es). The routine then repays the Matured Deposit or cancels the deposit which is not yet matured and pays the amount in cash or by Crediting it to the holders account.

4.2.8 CLS:

It asks for the date and closes the day's accounts like writing the clean cash books etc, prints the days reports and makes the Data Base unaccessable. (until an OPNDAY is executed) This routine is executed once every evening.

4.2.9 CRSHRC:

This is a CTL program consisting ofaset of monitor commands which first execute the system utility DBMEND. [3]. The utility undo's all the incomplete transactions and brings back the Data Base to a consistent and valid state. A

routine CRS.CBL is also executed by CRSHRC.CTL which does the five functions described in sec 3.8.

4.2.10 ACLIST:

It prints out the all the details contained in all the Ledgers. This is a application program which dumps the LEDGER AREA in a neat format.

4.3 TRANSACTIONS

In this section we examine how the various transactions are processed and each of those cases is compared with their counter parts in sec. 2.3.

4.3.1 Withdrawal : (Token)

The cheque/WF is presented to the ledger keeper by the customer. The customer receives a token (with a unique number on it) and is asked to wait. Now the counter clerk instead of finding the ledger book and going thro' the entries,, will select the withdrawal function (of the routine LDG). The balance and other details are displayed on the screen. He then verifies the balance and then types 'Y' to continue. The entry is made in the ledger by answering the questions appearing on the screen (instead of writing them on the book). Then the ledger keeper forwards the cheque/WF to the accountant who will also select the withdrawl function

(of his routine ACC). After typing in the token number, the last entry and the present (yet to be passed) entry are displayed on his screen. To pass the entry he types in ' Y' to the question appeared on the screen. The system then passes the entry and informs the cashier to pay the cash. The accountant also sends the passed cheque through the Transit Voucher register to the cashier. The cashier then calls out the token number and when the customer presents the token to him he types in the token number. The details of the cheque are then displayed on the screen. After he pays the cash, he types in 'Y' and the system makes an entry in the cash scroll and also enters the transactions in the corresponding Day Book. The cheque is then sent to the record room. (a short cut and fast method would be not to send the cheque to the cashier but instead pay the cash immediatly when the system informs the same to the cashier. This would save a considerable amount of time).

4.3.2 Withdrawal (Teller)

Unlike the existing method, in this system, the teller has the additional advantage of verifying the balance in the customer's account. When the customer presents the cheque/ WF to the teller he types in the details of the account upon which the balance (last entry) in that

account is displayed on the screen. After verifying the signature the cash is paid and 'Y' is type in. The system then gives a scroll number. That scroll number is written on the cheque and then sent through the transit voucher^{register} to the Ldg. Kpr. who makes an entry in the Ledger and the accountant validates it. (both of them select the TELRWDR functions their respective routines). The Day Book entry is made after the entry is passed.

NOTE

The Present Practice in computerised banks abroad (already getting obsolete since unmanned systems are taking over) is that : When the teller receives the chq/WF from the customer he types in the details of the A/C and then the system displays the last entry (balance) on the screen. He then verifies the signature and then types in the details of the cheque /WF. The system then makes all the entries at one go (Ledger, Cash Scroll and Day Book) while the Teller pays the cash and sends the cheque to the record room. In our implementation, this method is also coded and is provided as a choice to the bank administration. (This will replace the code of sec. 4.3.2.) . This is supposed to replace 4.3.2 only after the employees get accustomed to the low confrontation system.

4.3.3 Deposit Of Cash.

The cash and the pay-in-slip are received by the receipts cashier who types in the details of the Deposit. The system then enters it in the Cash Scroll and displays a Scroll No. That number is then put on the pay-in-slip and

is sent to the Head Cashier for verification. The Head Cashier then types the Scroll no. into his terminal and a copy of the Cash Scroll entry is displayed on his screen. He types a 'Y' to validate that entry, sends the pay-in-slip to the Account^{ant} and gives the counterfoil to the customer. The Accountant types in the Scroll No and the system displays the transaction details. The transaction is entered into the Ledger and Day Book after the Accountant gives his consent by typing 'Y' to the question 'Pass this transaction (Y/N) >>'. Then the pay-in-slip is sent to the record room.

4.3.4 Transfers.

The cheque with the filled in transfer slip is accepted by the counter clerk and (i) sent to the clearing section if it is an out-of-branch cheque, and when the cleared transfer slip comes back, the Ledger Keeper selects DEPOSIT and types in the details of the transfer and sends it to the Accountant. The Accountant types in the Deposit Scroll. No. and the system displays the transaction. The Accountant then types 'Y' to pass the transaction and enter it into the Ledger, Day Books, and sends the slips to the record room. (ii) if it is a local (same branch) cheque then the Ldg. Keeper selects the function Transfer and types in the details, (he also types in a Scroll No. or a transaction No) and

then sends both the cheque and the transfer slip to the Accountant . The Accountant also selects the transfer function and types in the Scroll (Transaction) No given by the Ldg. Keeper. Then the system displays the details of the Debit entry and asks the accountant whether to pass that entry or not. If the accountant responds by a 'Y', the system takes over and completes all the entries (both Debit and Credit entries in the Ledgers, Day Books and Transfer Scroll) and displays the same on the screen. The accountant sends both the cheque and the transfer slip to the record room.

It is to be noted that when compared to the existing system, in the above 4 cases, the process can be speeded up since there is no physical movement of books; and also that the effort of making the Day Book entry at the end of the day is reduced whereas that time can be spent for customers by increasing the Banking hours.

4.3.5 Opening An A/c.

After the application form is given to the accountant, the deposit is made in cash (with the pay-in-slip being marked ' New A/c ' to the receipts cashier. Now since the A/c No is not known, the cashier enters zero in that field. Then it is processed as any other deposit (thru the Head Cashier to the Accountant). The accountant

then selects the function OPEN AC and then ^{types in the} Deposit Scroll No and other details. The system then opens a new A/c and makes all the entries in the ledgers and Day Book. The new A/c No is then displayed on the screen and then the accountant prepares a passbook with that A/c. No. The formalities of taking the specimen signatures are also completed and the appl. Form and pay-in-slip are sent to the record room.

4.3.6 Closing An Account.

The accountant selects the function CLOSE AC which calculates the interest upto that date (if any is due) and then displays the balance. The accountant then informs the customer about the balance, and while the customer is preparing a cheque for that amount, returns to his other work. The cheque/ WF made by the customer comes to the accountant thru the Ldg. Kpr., who again selects CLOSE AC. This time when the balance is displayed the accountant types ' Y' to the query ' Continue >>'. Then he enters the cheque No, (or zero if it is a WF) and the TOKEN-NO. Then the system closes the A/c and displays all the entries of that Account. An option to print those entries is available. The syst^m informs the cashier and the payment is made. The system makes all the entries in all the required books. The Accountant then cancels the passbook and returns it to the customer.

4.3.7 Updating The Pass Book.

The Ldg. Kpr. selects the function BALANCE and then he types in the details of the A/c. He also types in the date from which the entries are to be displayed. The entries are displayed on the screen which the Ldg. Kpr. can enter into the Pass Book. The option of printing these entries on pre-printed stationary is also available.

4.3.8 Accepting Fixed Deposits.

Cash is deposited with the receipts cashier and it is processed as in sec 4.3.3 except that the pay-in-slip is sent to the fixed deposit Clerk (instead of the accountant) from the Head Cashier. The Fixed Deposit Clerk then selects the function ACCEPT DEP and types in the scroll No and other details. The system then creates a new fixed/cumulative Deposit and displays the details of the new deposit. The Clerk issues a Fixed Deposit Receipt and gets it signed by the Manager/ Accountant and gives it to the customer. The papers are sent to the record room and the system updates all the books.

4.3.9 Repaying Matured Deposits.

First, the formalities of surrendering the Deposit Receipt are completed (sec 2.4.9). The FD Clerk

then selects the function REPAY. Then all the Deposits with that customers name are displayed one after another. When the required deposit has been displayed, the search is stopped and then the system calculates whether any interest is due, and then asks the clerk ' to which Account it should be Credited ?'. If a zero is entered it asks for a token no (it pays in cash) otherwise it Credits the proceeds of the deposit to that Account whose No has been entered.

4.3.10 Cancellation.

While performing the above function (4.2.9), the system also checks whether the deposit is matured or not. If it has not yet matured, the system informs the user, and only after the user gives his consent to cancel, it cancels the deposit, makes all the entries and pay the customer as described in 4.2.9.

4.3.11 Payment Of FD Intrests.

4.3.11.1 In Cash:

The FD clerk selects the function PAYINT. Then all the fixed deposits of that customer are displayed one by one. When the required deposit has been displayed the serch is stopped and the system calculates the total

interest due on that deposit (upto the latest interval) and displays the amount of interest, the period for which the interest is given etc. The FD clerk then makes a Debit Voucher with those particulars and gives a token to the customer. The system informs the cashier to pay and meanwhile the FD clerk also sends the Debit Voucher to the cashier. The customer collects the payment at the cashier. The system will make the entries in Day Book, cash scroll etc. The Debit Voucher is then sent to the record room.

4.3.11.2 By Crediting To The Customers Account.

This is done automatically when the routine OPNDAY is executed in the morning. All those deposits for which interest is due by that day are checked and the interests are automatically Credited to the customers account. Later a print out is printed with the details of the fixed deposit no, interest paid, account to which ~~w~~sent, name, period for which the interest is given etc. All these Credits have their corresponding Debits made to the fixed Deposit Interest Account (2/1).

4.3.12 Calculation of SB A/C Interests.

This is also done automatically on executing OPNDAY (the first time OPNDAY is executed on or after Oct 1st/Apr 1st) and all the Credits having a corresponding Debit made to the SB Interests A/C (2/3).

CHAPTER 5

SYSTEM CONFIGURATION.

The hardware required is at least a mini-computer which supports a network Data Base system with COBOL .

5.1 STORAGE.

Let us estimate the storage (particularly secondary storage) requirements for a typical Branch where there are about 10,000 SB A/c 's, 1000 Current A/c's, 1000 fixed deposit A/c's and roughly 3000 transactions are done every day.

For every account, the ' ACC-REC' needs 30 words (120 Bytes). Also let us assume that on the average, there will be 50 entries in an SB A/c, 500 entries in a Current A/c and 10 entries in a fixed Deposit Account. Since each ' ENTRIES-REC' occupies 11 words (44 Bytes), the Storage requirements are:

SB Account : $120 + 50 \times 44 = 2320$ Bytes/Account.

Current Account: $120 + 500 \times 44 = 22,120$ Bytes / Account.

FD Account : $100 + 10 \times 48 = 580$ Bytes/ Account.

(since each ' FIXED-DEP-REC' needs 25 words (100 bytes) and

'INTEREST- PAID' requires 12 words (48 Bytes)). Hence the total storage requirements for the Accounts would be $(2320 \times 10,000) + (22,120 \times 1000) + (580 \times 1000) = 45.9$ Mega Bytes. Assuming each transaction has at least two entries (say Day Book and Cash Scroll), they require $9 + 7$ words respectively which amounts to 64 Bytes. The storage for 3000 transaction would be $3000 \times 64 = 192,000$ Bytes. Hence total storage requirements allowing for growth and other overheads would be 64 Bytes..

5.2 PERIPHERALS.

Assuming that there are three SB A/C counters, One current A/c counter, Two Tellers, a fixed Deposit Clerk, A Head Cashier and an Accountant, the total number of terminals (or Video Display Units) required are Ten. ie., one for each of the above employees and a system console. The other minimum peripherals required are a (preferably high speed) printer, and a tape drive. The backup of the Data Base is taken every day/ week onto the tape (off line storage) and kept under lock and key (preferably in a different building, from the one that houses the system).

5.3 POWER SUPPLY.

The system will require uninterrupted power supply (atleast during business hours). This requires the

setting up of a backup power source such as Genset. This is vital since the business in the bank comes to a standstill if there is no power.

Other requirements are the Air-conditioning of the room in which the system is housed, pre printed stationery etc..

CHAPTER 6

FURTHER DEVELOPMENTS

Though this system is initially developed, for possible installation, at major branches for the purposes of intra-branch transactions, with the addition of some communication software, inter-branch or inter-bank communication and hence inter branch/ bank transactions (transfers) are possible by sending queries over the network to another Data Base which is residing on a recipient machine. This could provide for faster clearing of cheques. Hence to start with, when a public Data Network becomes operational in India, banks in the major commercial cities can be linked with this facility, by which clearance of cheques will be made almost instantaneous.

Another development could be, as a second stage of the deployment of the system, to replace the conventional Token system for withdrawals by the Teller system. (By removing the present restriction which forbids tellers to pay amounts greater than Rs. 2000/-). (see sec. 4.3.2 NOTE). This is expected to increase efficiency and throughput rate since payment of cheques becomes instantaneous. (Service time reduces drastically). But this should be deployed only after the employees have had some hands on experience with the system described in Chapter Four. This requires only a small change in the existing software.

CHAPTER 7

CONCLUSIONS

We attempted to develop a computerised banking system which assists the Bank employees in working efficiently and help increase throughput rate. In our implementation, we have concentrated on all the aspects of the problem like Consistency, integrity, Concurrency, Crash Recovery and Security. As far as Security is concerned, although, our system is accident proof and prevents tampering by malicious users upto a certain extent, it is not absolutely fool-proof. Even the most sophisticated systems existing today can be cheated. For instance there was a recent press report about a fraud in a 'U.S.' bank. [6] Hence future research in this area should be directed towards devising fool-proof security methods.

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